Unveiling the synergistic effect of thermal aging and irradiation corrosion on the passivation performance and stress corrosion cracking of 308L stainless steel under high-temperature water environment

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Abstract This study investigated coupling of thermal aging with irradiation corrosion, and carried out the microstructure and electrochemical characterization of 308L stainless steel (SS). The passivation performance of 308L SS was studied under the simulated pressurized water reactor (PWR) environmental condition and its stress corrosion cracking (SCC) performance was tested under thermal aging-irradiation conditions. The experimental results indicate that thermal aging results in spinodal decomposition of δ-ferrite, giving rise to G-phase precipitate and carbide precipitate formation at δ/γ-phase interface, whereas irradiation causes Cr depletion and Ni enrichment at the interface. Both thermal aging and irradiation lead to the decreased corrosion resistance of 308L SS. Under coupling conditions of the two, severe Cr loss occurs at the phase boundary, which leads to severe corrosion on δ/γ phase boundary and also reduces SCC resistance of 308L SS.